

WHAT IS CLAIMED IS:

1. A hybrid drive system for an automotive vehicle, comprising:

(a) an engine operable by combustion of a fuel to generate a drive force;

(b) an electric motor;

5 (c) an output member operatively connected to a drive wheel of the vehicle for driving the vehicle;

(d) a planetary gear device having a first rotary element connected to said engine, a second rotary element connected to said electric motor, and a third rotary element;

10 (e) a first clutch through which said second rotary member is connected to said output member;

(f) a second clutch through which said third rotary member is connected to said output member;

15 (g) forward-motor-drive control means for engaging said first clutch and releasing said second clutch to thereby establish a forward motor drive mode in which the automotive vehicle is driven in a forward direction by operation of said electric motor while said engine is at rest;

20 (h) forward-engine-drive control means for engaging both of said first clutch and said second clutch to establish a direct engine drive mode in which the automotive vehicle is driven in the forward direction by operation of said engine, with said planetary gear device being rotated as a unit, and for releasing said first clutch and engaging said second clutch to establish an engine-and-motor drive mode in which the automotive vehicle is
25 driven in the forward direction by operations of both of said engine and said electric motor; and

(i) mode selecting means operable upon switching of a

vehicle drive mode from said forward motor drive mode to one of said direct engine drive mode and said engine-and-motor drive mode, for determining whether said engine is likely to stall if said direct engine drive mode is established, and commanding
5 said forward-engine-drive control means to establish said engine-and-motor drive mode, when it is determined that the engine is likely to stall if said direct engine drive mode is established.

10 2. A hybrid drive system for an automotive vehicle, comprising:

a vehicle drive power source including an engine operable by combustion of a fuel to generate a drive force, and an electric motor; and

15 non-cranking engine starting means operable upon switching of a vehicle drive mode from a forward motor drive mode in which the automotive vehicle is driven by operation of said electric motor only, to an engine drive mode in which the automotive vehicle is driven by operation of said engine, said
20 non-cranking engine starting means starting said engine by merely controlling the starting of said engine without cranking of said engine, when an operating speed of said engine is higher than a predetermined threshold, said controlling the starting of said engine comprising controlling a state in which said fuel is
25 injected into said engine.

3. A hybrid drive system for an automotive

vehicle, comprising:

(a) a vehicle drive power source including an engine operable by combustion of a fuel to generate a drive force, and an electric motor;

5 (b) a transmission;

(c) a clutch of a frictional coupling type disposed between said engine and said transmission;

10 (d) clutch-slip control means operable upon switching of a vehicle drive mode from a motor drive mode in which the automotive vehicle is driven by operation of said electric motor only, to an engine drive mode in which the automotive vehicle is driven by operation of said engine, said clutch-slip control means effecting a slipping engagement of said clutch ; and

15 (e) transition-input-torque estimating means for estimating an input torque of said transmission on the basis of an engaging torque of said clutch during said slipping engagement of said clutch while the vehicle drive mode is switched from said motor drive mode to said engine drive mode.

20 4. A hybrid drive system for an automotive vehicle, comprising:

(a) an engine operable by combustion of a fuel to generate a drive force;

(b) an electric motor;

25 (c) an output member operatively connected to a drive wheel of the vehicle for driving the vehicle;

(d) a planetary gear device having a first rotary element

connected to said engine, a second rotary element connected to said electric motor, and a third rotary element;

(e) a first clutch through which said second rotary element is connected to said output member;

5 (f) a second clutch through which said third rotary member is connected to said output member;

(g) forward-motor-drive control means for engaging said first clutch and releasing said second clutch, to thereby establish a forward motor drive mode in which the automotive vehicle is
10 driven in a forward direction by operation of said electric motor while said engine is at rest;

(h) forward-engine-drive control means for releasing said first clutch and engaging said second clutch, to thereby establish an engine-and-motor drive mode in which the automotive vehicle
15 is driven in the forward direction by operations of both of said engine and said electric motor;

(i) said first clutch being a frictionally coupling clutch; and

(j) first-clutch-releasing stand-by means operable upon switching of a vehicle drive mode from said forward motor drive mode to said engine-and-motor drive mode, said
20 first-clutch-releasing stand-by means reducing an engaging torque of said first clutch to a value not causing slipping of said first clutch, before said first clutch is released.

25 5. A hybrid drive system for an automotive vehicle, comprising:

(a) an engine operable by combustion of a fuel to generate

a drive force;

(b) an electric motor;

(c) an output member operatively connected to a drive wheel of the vehicle for driving the vehicle;

5 (d) a planetary gear device having a first rotary element connected to said engine, a second rotary element connected to said electric motor, and a third rotary element;

(e) a first clutch through which said second rotary element is connected to said output member;

10 (f) a second clutch through which said third rotary member is connected to said output member;

(g) forward-motor-drive control means for engaging said first clutch and releasing said second clutch, to thereby establish a forward motor drive mode in which the automotive vehicle is driven in a forward direction by operation of said electric motor while said engine is at rest;

15 (h) forward-engine-drive control means for releasing said first clutch and engaging said second clutch, to thereby establish an engine-and-motor drive mode in which the automotive vehicle is driven in the forward direction by operations of both of said engine and said electric motor;

(i) said first clutch being a frictionally coupling clutch; and

20 (h) clutch control means operable upon switching of a vehicle drive mode from said forward motor drive mode to said engine-and-motor drive mode, said clutch control means gradually reducing an engaging torque of said second clutch, and releasing said first clutch when a torque of said electric motor

and said engaging torque of said second clutch have satisfied a predetermined relationship representative of a ratio of said torque of said electric motor and said engaging torque of said second clutch with respect to each other, which relationship is
5 suitable for driving the vehicle in said engine-and-motor drive mode.